

PXIE MEBT 200 Ohm kicker technical specifications

The kicker is a part of the PXIE MEBT chopping system, which will prepare a pre-specified bunch structure of the 2.1 MeV H⁻ beam. For at least 80% of the time, bunches are directed to the absorber, and the remaining part (1 mA) of initially 5 mA, 162.5 MHz CW beam is sent to the linac.

The PXIE MEBT beam optics scheme assumes 2 travelling-wave kicker assemblies working in sync. The kicker electric field is generated by applying equal and opposite polarity voltage to the two opposing electrodes of each kicker assembly. The kick is in the vertical direction. Requirements below describe parameters of the 200 Ohm version of the kicker.

The 200 Ohm kicker assembly consists of a vacuum vessel, two identical helical travelling-wave structures with electrodes attached, and protection electrodes on both sides of the helices.

Helical structure

The design of the helical structure (“helix”) is based on the prototype shown in Fig.1. The helix consists of the central copper tube serving as the pulsed voltage signal return, a wire of a rectangular cross section wound around the tube in a helical shape, and electrodes attached to the wire. The position of the wire above the copper tube is determined by 4 ceramic spacers.

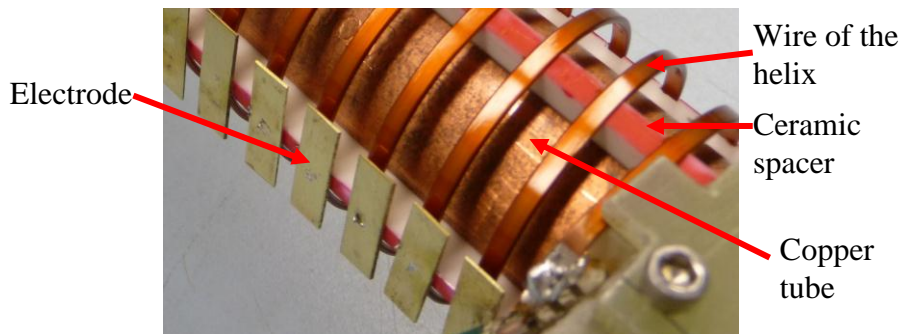


Figure 1. Element of a prototype helical structure.

Cross section of the helical structure (Fig. 1) looks like a 200 Ohm strip line with dimensions listed in the Table 1.

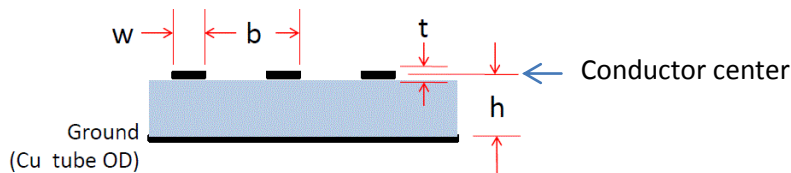


Figure 1. Cross section of the helical structure.

Table 1. Mechanical dimensions of the helical structure

Parameter	Value	Units
#13 wire dimensions (w x t)	.106 x .042	inches
Pitch (b)	.333 (8.46)	inches (mm)
Microstrip height above ground (h)	.189	inches
Copper tube, microstrip ground, OD	1.125	inches
Helix length (59 turns)	19.65 (49.90)	inches (cm)
Microstrip conductor total length, 59 turns	7.076	m
Helix diameter, microstrip conductor center-to-center	1.503	inches
Electrode dimensions	.220 x .787 x .020 (5.58 x 20 x .5)	inches (mm)
Ceramic spacer width, nominal	.135 +/- .005	inches

Other requirements:

1. Maximum electrode voltage with respect to the ground is 550 V.
2. The helix should dissipate the heat from pulsing of 5W evenly distributed along the wire length.
3. The kicker electrodes should withstand a steady-state heat load from the beam of 40W and an accidental loss of 20 J evenly distributed between all electrodes of the helix.
4. The kicker structure should not deteriorate from a steady-state radiation by 20 μ A tails of the H- beam.
5. All components should be high-vacuum compatible including the case with irradiation by H- beam.

Assembly

1. Two helical structures composing the kicker are mounted on one flange parallel to each other.
2. The gap between opposing electrodes is 16 mm.
3. The minimum distance between the helix's wire and any wall of the vacuum vessel is 70 mm.
4. The length of the vacuum vessel is 650 mm flange-to-flange.
5. Vacuum without the beam should be <100 nTorr.

Protection electrodes

The kicker assembly should incorporate two pairs of electrically isolated plates (protection electrodes) for protecting the kicker from accidental beam scraping. The beam current coming to plates will be measured, and the value of the plate current will be used as an indication of possible beam loss to the helix electrodes. Each pair is mounted near the ends of the helix so that creates a horizontal slit.

1. Slit height is 13 mm.
2. The minimum plate width is 40 mm.
3. Each plate should withstand a steady-state heat load from the beam of 40W and an accidental loss of 20 J.